

# Retrieval of Vegetation Water Content from Reflectance Using Genetic Algorithm-Partial Least Squares Regression and Neural Networks

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Remote estimation of vegetation water content has important implications in agricultural management practices and forest fire monitoring. Vegetation water content is also found useful in estimating leaf area index using optical remote sensing methods. This study aims to investigate the performance of genetic algorithms coupled with partial least squares (GA-PLS) modeling of spectral reflectance in retrieving equivalent water thickness (EWT) at leaf and canopy level, and to compare results from GA-PLS modeling with those from using artificial neural networks (ANN). The genetic algorithm is used to identify a subset of spectral bands sensitive to the variation in EWT, and PLS is then applied to relate the reflectance of the identified bands to EWT values. The advantage of using ANN is to model nonlinear transfer functions at a higher accuracy than regression analysis.

GA-PLS and ANN were applied to LOPEX dataset, datasets simulated by a leaf radiative transfer model PROSPECT and a canopy radiative transfer model SAILH, and to remotely sensed AVIRIS and MODIS imagery. The results indicate that GA-PLS and ANN both have capability of retrieving EWT from measured and simulated leaf reflectance, and achieved very good prediction ( $r^2 > 0.90$ ). The retrieval of using real and simulated canopy data indicates that both GA-PLS and ANN have degraded performances due to the effects of soil background and leaf dry matter on the reflectance, but the retrieving accuracies were still highly valuable. The result also shows that although nonlinear transfer functions were used, ANN did not always outperform GA-PLS, indicating that GA-PLS has the capability to accommodate nonlinearity.

Keywords: Equivalent water thickness; Spectral reflectance; AVIRIS; MODIS; Genetic algorithm; Partial least squares; Artificial neural networks